

including the lakes Ontario, Huron, and Erie, the river St. Lawrence, and the coast of Labrador. Captain Bayfield, in times of leisure from his surveying duties, was accustomed to observe occultations of stars by the Moon, the phenomena of *Jupiter's* satellites, &c. Some of these observations are recorded in the *Monthly Notices*. At Quebec he observed the transit of *Mercury* of May 5, 1832, with one of Jones's $3\frac{1}{2}$ -foot achromatic refractors. In 1848 he communicated to the Society an excellent series of observed occultations of stars by the Moon and phenomena of *Jupiter's* satellites made at his residence at Charlottetown, Prince Edward Island, together with the resulting determinations of the longitude of his residence, from which he deduced the longitude of the Observatory Bastion at Quebec. The reductions appear to have been made with some care, after applying to the tabular places of the Moon corrections furnished by the Astronomer Royal.

Admiral Bayfield attained the rank of Post-Captain in 1834, Rear-Admiral in 1856, and Admiral in 1867. His death took place at Charlottetown on February 10, 1885, in the ninetieth year of his age. He was at the time of his decease the senior Fellow of the Society, and the last of the "non-resident" Fellows, having been elected on May 11, 1827.

CAPTAIN SIR FREDERICK J. O. EVANS, R.N., K.C.B., F.R.S., entered the Royal Navy in the year 1828, and served in H.M. ships *Rose* and *Winchester*, on the North American station, until 1833, when he was transferred to H.M. surveying-vessel *Thunder*, Commander Richard Owen, and was employed until 1836 in surveying operations in various parts of the West Indies.

It was in this ship, and under the guidance of her able captain, that he imbibed those scientific tastes which formed his character later in life, and laid the foundation of a career of usefulness, uninterrupted to its close, and which has perhaps rarely found a parallel in the naval profession.

Mr. Evans subsequently served in the *Caledonia*, the flagship in the Mediterranean, the *Asia*, the *Rapid*, the *Rolla*, the *Dido*, and *Wolverene*, of which two latter ships he was acting master. He was confirmed in that rank in 1841, and was then appointed to H.M.S. *Fly*, Captain F. P. Blackwood, fitting for special exploring and surveying service in Australia and New Guinea, where he was continuously employed until 1846. He took a very leading part in the examination of the Coral Sea, the Barrier Reefs of Australia, Torres Strait, and the neighbouring shores of New Guinea, regions then comparatively unknown. After a short period of surveying service on the home coasts, Evans was appointed to the *Acheron*, under the late Admiral Stokes, and was engaged until 1851 in exploring and surveying the coasts of the then young colony of New Zealand; in both these important enterprises he took a very conspicuous part, and gained for himself the reputation of a skilful and scientific surveying officer, second to none in the profession.

During the Russian War Evans was employed in the Baltic on special reconnoitring service, and was attached to various ships of the fleet, taking an active part in the operations against Bomarsund and among the Aland Isles, for which he was mentioned in gazetted despatches.

It may be truly said that for many years of his life Evans was a zealous contributor to magnetic science. He had already begun to make observations of the three magnetic elements whilst employed on hydrographic work in H.M. ships *Fly* and *Acheron* in the Australian Colonies and New Zealand, between the years 1842 and 1851; but it was not until 1855, when he became Superintendent of the Compass Department of the Royal Navy that he was able to devote himself entirely to the magnetism of iron ships, a subject which was then growing yearly in importance, from the increasing amount of iron used in fitting as well as construction even before iron plating had brought about an actual crisis.

Sagaciously foreseeing the important part the science of magnetism was destined to play in the Navy, then being revolutionised by the change from wood to iron, he devoted his whole energies to the study of the subject until he had made himself completely master of it.

In 1865 Capt. Evans was appointed Chief Assistant to the Hydrographer, retaining his position as head of the magnetic department; this post he continued to hold until the early part of 1874, when a vacancy occurring in the Hydrographership of the Admiralty he was selected to fill it, and continued to do so with equal ability and conscientiousness until within a little more than a year of his death.

From the time of his first appointment in 1855 as Chief of the Admiralty Compass Department until his death Capt. Evans (in happy co-operation during a great part of the time with that great mathematical genius Archibald Smith) devoted himself heart and soul to the solution of what was really a question of life and death to the British Navy, and indeed to seafaring people all over the world. The question was whether it was possible so to deal with the disturbing element of iron, then entering largely into the construction of ships of all kinds, as to prevent the time-honoured compass from becoming a useless toy, or even a misleading guide. Now that the difficulty has been grappled with and conquered, we have half learned to forget the magnitude of the peril. But for the scientific and practical progress due to the labours of Capt. Evans and Archibald Smith we might almost with advantage have thrown all our compasses overboard. The attraction due partly to the inherent and partly to the induced magnetism of iron ships, and especially of plated ships, was so violent as to induce in some vessels, in certain positions, errors of two, three, or four points of compass indication. Something had been done to explain the causes of the mischief and to suggest palliatives. Famous old Flinders, at the

beginning of the century, had spelt out the mystery so far as it was disclosed by the wooden ships of his time, but he had to deal with comparatively minute errors due to induction alone, and was never brought face to face with the stupendous difficulty which iron shipbuilding and iron ship-plating afterwards created. Sir George Airy had done good and sound work in the earlier days of iron, but much more was needed to overcome the serious trouble which the newer types of mercantile and still more of naval vessels threatened to bring upon us.

It was at this critical epoch that Capt. Evans and Archibald Smith began to work together. Years of experimental labour and mathematical research went to the production of the "Admiralty Manual on Deviations of the Compass"—a book perhaps as perfect in its kind as a book could be. It is hard to do justice to the elegance of the mathematical handling, and, above all, to the happiness of the graphic methods which are found in the Manual, without seeming to indulge in extravagant laudation.

The various steps of Evans's work may thus be stated:—

In 1858 a Chart of Curves of Equal Magnetic Declination, compiled by him for that epoch, was published by the Admiralty. This chart appeared most opportunely, for, with compass errors growing in amount and complexity, the mariner was by means of it enabled to ascertain in any part of the navigable world how far his compass deviated from the magnetic north.

In 1859 he read a paper on the magnetism of iron ships at the Royal United Service Institution. This was a valuable *résumé* of all that had been hitherto done in order to obtain a knowledge of the magnetism of iron ships and the treatment of their compasses. He also communicated some results of Archibald Smith's method of analysis as applied to the errors of the compass found in H.M. ships.

Evans's next paper consisted of a Report to the Hydrographer of the Admiralty on Compass Deviations in the Royal Navy. It treated of the magnetic character of the various iron ships in the Navy, and also of the *Great Eastern* steamship. The results of this paper were (1) to show the best direction for building an iron ship; (2) the best position for placing her compass; (3) the various sources of error affecting a compass under favourable conditions. This report was communicated to the Royal Society, and published in their "Transactions" in 1860.

In 1861 he read a paper of similar import before the Institute of Naval Architects.

Reference has already been made to his work on the *Great Eastern*, and an important result of it was the experimental investigation which he was led to make as to the cause of the abnormal errors of the compasses in that vessel, proceeding from the application of Airy's system of magnet and soft-iron correctors when long single-compass needles are used.

With Evans principally as an experimentalist and Archibald Smith as the mathematician, a valuable paper on the proper

P

length and arrangement of the needles on a compass card, together with exact information as to the proper arrangement of magnet and soft-iron correctors with respect to it, was presented to the Royal Society in 1861, being the result of the joint work of those ardent investigators into the compass question in iron ships.

Commencing with this latter paper, we find Evans and Smith, as we have said above, generally working together, and under their joint editorship there appeared in 1862 the first edition of the "Admiralty Manual for Deviations of the Compass." The introduction, however, of armour-plated ships soon rendered a new edition necessary, and in 1863 it was published. This work was again revised in 1869, and became the text-book of the world on the important question of the deviations of the compass in iron ships of whatever form, being translated into all the principal European languages.

In 1865 Evans and Smith produced another important paper on the "Magnetic Character of the Armour-plated Ships of the Royal Navy," which was published in the "Phil. Trans. Roy. Soc."

It was only natural that a joint editor of the "Admiralty Manual for Deviations of the Compass," who knew the difficulties of that work for his fellow-seamen, should wish to present the subject, on which he had worked so long, in an elementary form more suitable to their every-day requirements. Evans therefore, in 1870, published his "Elementary Manual for Deviations of the Compass," a work which has been very well received by the nautical world, and has been translated into various European languages.

With the exception of some papers read at certain meetings of the British Association, and two lectures read at the Royal United Service Institution in 1865 and 1872, Evans subsequently relaxed his personal investigations into the magnetism of iron ships, and turned more to terrestrial magnetism.

Thus, in 1872 he contributed a paper to the Royal Society, on the magnetic declination in the British Islands, and compiled the magnetical instructions for the voyage of H.M.S. *Challenger*, being again assisted in this, and for the last time, by his old fellow-labourer, Archibald Smith.

Lastly, in 1878, Evans read an able and instructive lecture, on the magnetism of the earth, before the Geographical Society, showing the distribution and direction of the earth's magnetic force and the changes in its elements as then known.

Captain Evans was elected a Fellow of the Royal Society in 1862. He sat for many years on its Council, and was more than once a Vice-President. He was also a Fellow of the Royal Astronomical and Geographical Societies; he served for many years as member of the Meteorological Committee of the Royal Society, and on the change in the constitution of that body became a member of its Council.

In recognition of his public services the Companionship of the Bath was conferred upon him in 1873, and in 1881 he was advanced to Knight-Commandership of the same order.

Sir Frederick Evans's last public service after his retirement from the Admiralty in 1884 was as the British Delegate at the Congress of Washington for the establishment of a prime meridian and questions kindred to it.

He died on December 20, 1885, in his 71st year.

He was elected a Fellow of this Society on December 12, 1856.

MAJOR-GENERAL JOHN CAULFIELD HANNYNGTON, Fellow of the Institute of Actuaries, was born in Dungannon, Co. Tyrone, on March 7, 1807. He entered the army as a cadet in 1825, and served in the 24th Regiment of Native Infantry until, on the suppression of the Colekan insurrection, he received a political appointment, and was placed in charge of the Mambhoom Division on the southern frontier, where he remained until, in 1842, he was selected to fill the highest judicial position on the frontier, that of Judicial Commissioner.

On his promotion to the rank of Lieut.-Colonel, in 1856, he returned to regimental duty, in accordance with the regulations of the Service, and took command of the 63rd B.N.I. He was with his regiment at Berhampore at the time of the Mutiny in 1857, and was for some time in command of the station. The 63rd did not mutiny, but were disarmed.

The reputation which Colonel Hannyngton had acquired led very shortly to his transfer to the Military Finance Department, and finally to his appointment as Military Auditor-General, in which office he remained until the close of his active military career in 1861, when he retired on his pension.

Throughout nearly the whole of his service General Hannyngton sedulously watched over the affairs of the Bengal Military and Orphan Funds, and placed his knowledge, his skill, and his labour gratuitously at the disposal of the directors of those splendid institutions. He was, in fact, their most able consulting actuary. True it is that to his sympathetic nature it was always a labour of love to work for the widow and orphan; but only those who know the responsibilities, anxieties, and arduous nature of the actuarial duties connected with institutions of the magnitude of the Bengal Military and Orphan Funds can duly appreciate the self-sacrificing devotion of one who voluntarily and gratuitously undertook such onerous duties in addition to his daily official work in the administration of justice in a large province.

After his retirement the services of General Hannyngton, as a skilful actuary, were on several occasions called into requisition by the Secretary of State for India with regard to the affairs of the Staff Corps and on other matters. To him are due also the whole of the calculations and arrangements under which the Government took over the Annuity and Civil Funds of the